Table of Contents

CHAPTER 11.0   EFFECTS OF NURSE STAFFING ON NURSING HOME QUALITY MEASURES[1]

11.1   Introduction

The aim of this Congressionally mandated study is to answer the following empirical question: Is there some ratio of nurses to residents below which nursing home residents are at substantially increased risk of quality problems?

This question arises from the policy issue of whether minimum staffing standards should be required in nursing homes and if so, at what level. Thus, we are testing the hypothesis that identifiable thresholds exist below which quality of care is compromised. We do not need to demonstrate a linear relationship between staffing and quality of care, which clearly may not exist. Depending upon the nature of the relationship between staffing and quality, multiple thresholds associated with incremental increases in quality, rather than a single inflection point above which there is no added benefit of additional staffing, may exist. Our hypothesis is that staffing levels of RNs, LPNs, and nurse's aides are associated with both quality of care and quality of life as measured by traditional quality measures.

This chapter discusses analyses of primary data that were previously collected by the University of Colorado to assess quality of care in nursing homes. Trained nurses collected the data via chart reviews, direct observation, and staff interviews. The process yielded quality measures at the resident level that were aggregated to the facility level. In this analysis we focused on two of these measures that were most likely to be related to staffing and not independently measured in other data sources.

Inappropriate weight loss, often a sign of malnutrition, remains a prevalent problem in nursing facilities and is frequently used as a marker of poor care (Kayser-Jones, 1997; Kayser-Jones & Schell, 1997). Governmental oversight has attempted to reduce the occurrence of weight loss through legislative changes and increased regulatory control. The Omnibus Reconciliation Act of 1987 (OBRA '87) specifically requires nursing homes to provide 'dietary services that assure that the meals meet the daily nutritional and special dietary needs of each resident' (Omnibus Budget Reconciliation Act of 1987). To facilitate identification of patients losing weight, the nationally-used resident assessment instrument, the Minimum Data Set (MDS), requires documentation of patients' weight status every 90 days. For any individual losing greater than 5% of body weight over 30 days or 10% over 180 days there is supposed to be documentation on the MDS, followed by additional evaluation to identify the reasons for the weight loss and to develop interventions. Thus, nursing staff are mandated by OBRA '87 to

document weight loss and alter their care plans to aid in reversing decline. This creates a disincentive for facilities to report weight loss on the MDS, making an independent data source preferable to the MDS in this area. Correspondingly, we gather our data from the residents' medical charts.

Prior research has shown that malnutrition and weight loss in the elderly may be an indicator of inadequate staffing to meet the increased demands of a frail population (Kayser-Jones, 1997; Kayser-Jones, Schell, Porter, Barbaccia, & Shaw, 1999). While weight loss may be an indication of underlying illness, such as cancer, there are multiple other causes that are potentially reversible (Keller, 1993; Morley & Kraenzle, 1994; Ryan, Bryant, Eleazer, Rhodes, & Guest, 1995). Frequently, the cause is related to one of the common problems in the elderly that impairs their ability to easily obtain appropriate nutritional intake. For example, dementia, swallowing difficulties (e.g., due to stroke) or physical immobility can limit a person's intake (Hall, 1994). To overcome these limitations, nursing staff need to recognize the problem and change their approach. Facilities that do not have appropriate staff to handle the increased feeding needs of their residents are more likely to have difficulties maintaining their weight.

Resident cleanliness and grooming is a continued concern of residents, their families, staff and regulators. Cognizant that a long-term facility not only provides medical care and assistance, but is also a resident's home, OBRA '87 regulations specifically state the need for facilities to maintain a resident's quality of life. The loss of control over one's life has been found to adversely affect one's outlook (Barder, Slimmer, & Le Sage, 1994; Rice, Beck, & Stevenson, 1997). Tasks such as grooming increase a person's perception of self and independence (Tolley, 1997). While the MDS requires documentation of a resident's ability to carry out activities of daily living (ADLs), there is no assessment of the resident's appearance and hygiene. Our data include independent evaluations of this aspect of care.

Residents who are ungroomed may reflect a lack of appropriate nursing care. Since a large proportion of nursing home residents requires assistance with ADLs, staffing levels, especially nursing aides, may have a significant impact on resident grooming and cleanliness.

11.2   Methods

11.2.1 Design

The study is designed to examine associations between different types of nursing home staff, which are measured at the facility level, and quality measures, which are aggregated from the patient level, after controlling for facility case mix. Thus, the unit of analysis is at the facility level, such that quality measures represent facility rates. Although staffing may not have a linear relationship with quality, the design included use of ordinal staffing and quality measures. Thresholds were estimated by assessing the relationship between quartiles of staffing levels with above average facility rates for a quality

measure (i.e., increased rates of a poor outcome). For each quality measure, we tested several thresholds in an attempt to identify the staffing ratio (or ratios) for each staff type that was most strongly associated with quality differences. We modeled the relationship between low staffing levels and quality using thresholds at the lowest 10%, 20%, and 30% of facilities and also used a recursive partitioning approach to find the staffing splits that explained the most variance in quality. We used multivariate methods to adjust for resident characteristics, but did not adjust for facility characteristics that were themselves strongly associated with staffing (e.g., for profit/non-profit, hospital-based/freestanding) because such adjustment would merely weaken the association between staffing and quality by using a proxy for staffing in the model.

11.2.2 Sample

Primary data were collected in three prior studies conducted by the University of Colorado under subcontract to Abt Associates to assess quality of care. Trained nurse evaluators visited a total of 55 facilities in 17 states. Thirty-eight facilities were in six states (Kansas, Maine, Mississippi, New York, South Dakota and Texas) participating in the Nursing Home Case Mix and Quality Demonstration in 1998 (Kramer, Lin, Louwe, Ecord, & Kowalsky, in preparation). In 1997, fifteen facilities in 11 states (California, Iowa, Illinois, Indiana, Michigan, New York, Ohio, Pennsylvania, Tennessee, Texas, and Wisconsin) were visited as part of an independent evaluation of the JCAHO accreditation process (Kramer, Kowalsky, Lin, & Ecord, 1998). The remaining two facilities operated in California and were visited as part of a General Accounting Office evaluation of the state's nursing home survey process (United States General Accounting Office, 1998).

Data were collected on approximately 80 residents per nursing home in these studies, yielding data on over 4,000 individual residents. The long-stay random sample that is used in this study included approximately 40 residents per facility who were in the facility on the day of the site visit and had been in the facility for at least 105 days (sufficient time for at least two MDS forms to be completed).

Since the unit of analysis is at the facility level, statistically significant relationships may be difficult to find in this small sample (n=54). However, we will examine the pattern of results for these variables in the context of our other findings to find trends in relationships between staffing levels and quality that are supported by more than one measure.

11.2.3 Measures and Data

11.2.3.1 Quality Measures

We considered an array of quality measures representing both outcome and process dimensions of quality. Quality measures in the analysis were selected based on 1) a clear hypothesized association with staffing levels for different types of nursing care, 2) the need to include quality of life as well as

quality of care measures, and 3) emphasis on incidence versus prevalence measures.

Weight loss was defined as evidence of greater than a 5% loss of in the preceding 30 days, or 7.5% in 90 days, or 10% in 180 days as compared to the resident's most recent weight. Weight loss was an incident measure that was likely to be associated with all levels of nursing care. Aides are typically entrusted with the responsibility of feeding residents with food intake difficulties (e.g., dementia, swallowing problems, etc.). LPNs and RNs are required to properly oversee feeding, and are required to document evidence of weight loss. This latter problem requires skilled nursing to alter and implement a proper care plan to try to reverse a resident's decline.

A resident's hygiene at the time of inspection reflects both quality of care and quality of life. Residents were identified as ungroomed, if upon inspection, they were unclean, unshaven, had uncombed hair, or had body odor. Likewise, dirty or absent dentures, dirty or broken glasses, or soiled clothing also were cited as evidence of poor care. Patients who are ill-kempt or not dressed are indicative of a staff too rushed or unwilling to perform ADLs for impaired residents. The primary data quality measures were aggregated to the facility level.

11.2.3.2   Covariates

The association between staffing and quality can be confounded by case mix. Staffing needs are likely to differ based on the illness and frailty of the patients in any given facility. While it is not clear how to incorporate case mix into policy recommendations, in the analysis it is essential that we control for it. Without adequate control for case mix, we may find that facilities that staff most heavily will score worse on the quality measures because their residents have the greatest care needs and are at greatest risk of poor outcomes.

Due to our limited sample size and our desire not to over-fit our model, medical conditions for risk adjustment were limited to two for each dependent variable. For weight loss, adjustment took into consideration the number of residents with low body mass indexes (BMI) and/or psychiatric diagnoses. Adjusting for residents with BMI below 21, per chart review, accounts for residents with likely terminal diagnoses. Psychiatric diagnoses were obtained from chart review. Their inclusion was to account for patients that may be losing weight due to underlying psychological problems including mood disorders (e.g. depression), psychotic and delusion disorders. While many psychiatric disorders are amenable to treatment, responses to medication can be slow. For example, Morley found that 36% of residents with weight loss were found to be depressed (Morley & Kraenzle, 1994). For poor hygiene/ungroomed, adjustments were made for psychiatric diagnoses and patient self-reports on their ability to dress themselves. Poor dressing performance included residents that were noted to require extensive assistance or total dependence on the MDS.

11.2.3.3   Staffing

Four different staffing measures were used: nurse's aide hours per resident day, LPN hours per resident day, RN hours per resident day, and the sum of RN and LPN hours per resident day. Analysis of each type of staff was conducted separately because, from a policy and clinical perspective, we need to be able to isolate the effects of different types of staff on quality. However, for many functions, there is widespread substitution between RN and LPN staff in nursing homes, due to the limited availability of RNs and also the significant experience that some LPNs have had in nursing home care. This is not to say that their qualifications are equivalent, only that they may function in similar roles in different nursing homes depending upon staff availability. While relationships between LPN staffing or RN staffing and quality may not be strong, it is possible that the sum of these two types of staff are significantly associated with quality.

Staffing levels were obtained from the Online Survey, Certification, and Reporting System (OSCAR) database from 1996 and 1997. During each inspection, a nursing home reports to the Health Care Financing Administration information concerning staffing levels, occupancy rates and other facility characteristics. In a separate chapter, Abt Associates has assessed the validity of OSCAR staffing data by comparing it to payroll data from a sample of Ohio nursing homes in 1998 and 1999 (Chapter 8). The Pearson correlation coefficient between OSCAR and payroll data was 0.51 for RNs, 0.54 for LPNs, and 0.39 for nurse's aides. OSCAR data were not available for one of the California sites, limiting our sample size to 54 facilities.

11.2.4 Analysis

11.2.4.1   Descriptive Analysis

We determined the mean, median, range, and interquartile range for all of the study variables including quality measures, covariates, and staffing measures. Correlational analyses among the variables, including staffing levels and quality measures, covariates and quality measures, and facility variables and staffing levels were conducted.

11.2.4.2   Risk Adjusted Analysis

Logistic regression analysis was used to estimate the likelihood of a facility being in the top half of facility rates for each of the quality measures, at different staffing thresholds. Due to the limited number of facilities, staffing levels were examined at the 25th percentile (lowest quartile) and the mean. Regression models were adjusted for the case mix covariates.

11.3   Results

Means and standard deviations for staffing, quality measures, covariates, and facility characteristics are

included in Table 11.1. Quartile ranges for staffing are included in Appendix E., Table 5. For staffing, the mean values represent the average number of hours per resident for each type of staff. Means for the quality measures represent average facility rates. The distributional characteristics for the quality measures reflect skewed distributions in which the worst quartile of facilities are substantially worse than the median in rates of quality problems (AppendixF., Table 5). The facilities were predominately urban with occupancy rates approaching 90%. Slightly more than half were part of a multi-facility organization and/or a for profit facility.

Table 11.1 Descriptive statistics for staffing, quality, case mix, and facility measures		
Measure	Mean	Standard Deviation
Staffing (n=54):		
Aide hours per resident day	1.99	0.65
LPN hours per resident day	0.62	0.33
RN hours per resident day	0.49	0.25
RN+LPN hours per resident day	1.11	0.37
Quality Measures (n=55):		
Unclean or ungroomed	8.22	9.34
Significant weight loss	9.71	6.68
Covariates (n=55):		
Dementia	72.40	10.40
Body mass index <21 kg/m^2	30.97	9.31
Dressing impairment	64.14	16.56
Psychiatric diagnosis	17.03	10.53
Facilities (n=55):		
Urban	63.64	---
Chain	58.18	---
Proprietary	52.73	---
Occupancy rate	87.50	10.67

The associations between staffing and the quality measures varied by type of staff. Table 11.2 shows the likelihood that facilities are in the worse half of the distribution on the quality measures at different staffing levels after case-mix adjustment.

The regression models for significant weight loss indicate that low-staffed facilities are more likely to have high (above average) rates of resident weight loss (Table 11.2). While only nurse's aide staffing at 1.99 hours per resident day and licensed staffing (RN plus LPN) were statistically significant at the p<0.10 level, the models suggest a common trend that lower staffing is associated with a higher rate of quality problems. The small sample size of 54 facilities makes it difficult to achieve statistical significance even with substantial odds ratios. For nurse's aide hours per resident day, facilities in the

lowest quartile (those below 1.55 aide hours per resident day) of the staffing distribution are almost two-and-a-half times more likely than those in the top three quartiles (those above 1.55 aide hours per resident day) to be among those facilities with above average rates of significant weight loss (OR=2.35, 95%CI 0.58 – 9.54, p<0.231). Expanding the threshold to include all facilities below the mean staffing level for nurse's aide hours (1.99 aide hours per resident day), we find that these facilities are more than three times more likely than those above this threshold to have a high rate of significant weight loss (OR=3.15, 95% CI 0.87 – 11.36, p<0.080). Hence, we find that the ratio of nurse's aide hours to residents has a significant impact on the incidence of weight loss, with fewer hours/day putting a facility at a significant risk of having a high rate of this quality of care problem.

Table 11.2 Likelihood of quality measure occurrence below vs. above the specified staffing

Quality Measure	Staff Type	Staffing Hours per Resident-Day*	Adjusted Odds Ratio (95% CI)[†]	p- value	% of Facilities Below Staffing Hours[‡]
Significant weight loss	Aide	Below 1.55	2.35 (0.58 - 9.54)	.231	25.9
	Aide	Below 1.99	3.15 (0.87-11.36)	.080	55.6
	LPN	Below 0.41	1.40 (0.34 - 5.80)	.646	24.1
	LPN	Below 0.62	1.13 (0.35 - 3.59)	.840	50.0
	RN	Below 0.28	1.22 (0.32 - 4.59)	.770	24.1
	RN	Below 0.49	1.86 (0.56 - 6.13)	.310	53.7
	RN+LPN	Below 0.85	2.57 (0.67 - 9.94)	.171	25.9
	RN+LPN	Below 1.11	4.73 (1.21-18.51)	.026	55.6
Unclean and/or ungroomed	Aide	Below 1.55	1.26 (0.34 - 4.64)	.728	25.9
	Aide	Below 1.99	0.91 (0.26 - 3.22)	.887	55.6
	LPN	Below 0.41	0.47 (0.13 - 1.67)	.244	24.1
	LPN	Below 0.62	0.30 (0.09 - 1.00)	.051	50.0
	RN	Below 0.28	1.56 (0.45 - 5.41)	.483	24.1
	RN	Below 0.49	8.68 (2.10-35.82)	.003	53.7
	RN+LPN	Below 0.85	1.80 (0.51 - 6.33)	.360	25.9
	RN+LPN	Below 1.11	0.98 (0.33 - 2.88)	.966	55.6

* Staffing level representing the treatment variable ("1" denotes below and "0" denotes above) in the logistic regression   model estimating the effect on quality.

† Odds that a facility with staffing hours per resident day below the cutoff will be in the worst quality decile relative to   facilities with staffing hours per resident day above the cutoff, after adjusting for case mix variables.

‡ The percentage of nursing homes in New York with staffing hours per resident day below the tested cutoff.

In comparison, the impact of either licensed or registered nurse staff on weight loss among these facilities does not appear to be as big when analyzed individually, but in sum, seems to be just as important as the nurse's aide staffing levels. For LPN hours per resident day, comparison of those facilities in the lowest 25% to those in the top 75% of the distribution yields no discernible difference

(p<0.646) after case-mix adjustment. Likewise, comparison of those facilities above and below the mean LPN staffing level does not appear to be meaningful (p<0.840). Paralleling this trend, the RN staffing levels that we analyzed did not yield statistically significant results at either the quartile or mean thresholds. More importantly, when we analyze the sum of RN and LPN hours per resident day (total licensed staff), we see a strong trend at the quartile threshold, albeit a statistically non-significant one (OR=2.57, 95% CI 0.67-9.94, p<0.171), and a statistically significant one at the mean staffing level for combined RN+LPN hours per resident day (OR=4.73, 95%CI 1.21 – 18.51, p<0.026). Interpreting this finding, one could say that facilities staffing below 1.11 combined RN+LPN hours per resident day are almost 5 times more likely than those facilities above 1.11 RN+LPN hours per resident day to exhibit an above average rate of significant weight loss.

For the quality measure based upon a facility's rate of residents being unclean or ungroomed, the case-mix adjusted models did not establish as strong a relationship between low-staffed facilities and high rates of residents being unclean/ungroomed. Upon examination of the results listed in Table 11.2, one might see that the odds ratios for the lowest quartile and mean threshold models are not very consistent. The disparity between the models for aide hours per resident day suggest that there is no statistically significant difference between those facilities that staff above or below the particular thresholds that we have tested. In the model comparing the lowest 25% of the nurse's aide hours per resident day distribution to those in the upper 75%, the chi-square test of association indicates that there is a little evidence to suggest that these facilities are different in terms of residents being unclean/ungroomed (p<0.728). Likewise, those facilities that are below average in terms of nurse's aide hours per resident day (the threshold is at 1.99 nurse's aide hours/resident day) are not too different from those above average in nurse's aide staffing (p<0.887).

Looking at the licensed and registered staffing levels in relation to the probability that a facility will have a high rate of unclean/ungroomed residents, we find some relationships that may require further analysis to understand. Similar to the models for significant weight loss, we must consider the effect of LPN and RN hours individually and in relation to one another. If one examines the results of solely the LPN models at the lowest quartile and mean staffing levels, the interpretation might be that facilities with low LPN hours per resident day are actually at a lower risk of having a higher-than-average rate of ungroomed residents. For instance, facilities that are below the 0.41 LPN hours per resident day level are only half as likely to exhibit a high rate of ungroomed residents (OR=0.47, 95%CI 0.13 – 1.67, p<0.244). Using the staffing threshold at the mean staffing level for LPN hours, we find a statistically significant result that supports the findings at the lowest quartile staffing threshold (OR=0.30, 95%CI 0.09 – 1.00, p<0.051). However, if we look at the models using RN staffing thresholds, we see the converse relationship. For example, facilities staffing below the lowest quartile of the distribution for RN hours per resident day (below 0.28 RN hours per resident day) are one-and-a-half times more likely to have a high rate of ungroomed residents (OR=1.56, 95% CI 0.45 – 5.41, p< 0.483). Those facilities staffing below average for RN hours per resident day are more than eight times more likely to have a high rate of ungroomed residents (OR=8.68, 95% CI 2.10-35.82, p<0.003). These differences

may reflect substitution of LPNs and RNs, such that facilities high in RNs are actually low in LPNs.

If this were the case, there would be no association between quality and combined RN and LPN time, as we found. When we included RN and LPN in the model as separate independent variables, the likelihood of an above average rate of ungroomed residents was 7.2 times greater for RN staffing level below 0.49 hours (p<.008), with no significant effect of LPN hours. Therefore, the RN hours are the important predictor of quality, not the LPN hours.

11.4   Discussion

An association was seen between significant weight loss and combined RN and LPN hours per resident day and with nurse's aides hours. While aides are primarily responsible for assisting with feeding residents, RNs and LPNs provide regulatory oversight. Also, the skilled staff are responsible for appropriately monitoring weight loss, and subsequently, are charged with altering the care plan. The independent associations with RNs and LPNs were suggestive but not statistically significant. These results may reflect some overlap of responsibilities between LPNs and RNs in different nursing homes, implying that the total amount of licensed staff is the crucial staffing issue for proper nutritional care.

The association between staffing and grooming was more complex. Significant relationships were found for LPN and RN staffing, although the data showed that more RN hours and fewer LPN hours yielded better outcomes for this quality measure. With both RN and LPN included in the model, however, only RN was significant. These findings suggest that facilities high in RN hours are less likely to have quality problems and facilities that are low in RN hours are more likely to have quality problems. Further, the findings imply that LPNs do not substitute for RNs in this type of care, which probably involves extensive supervision of nurse's aides. We would expect an association between nurse's aide staffing levels and hygiene/grooming, but several issues may explain the lack of association. Nurse's aide staffing data from OSCAR were not very highly correlated with payroll data, suggesting staffing data inaccuracies. In addition, other factors related to nurse's aide staffing such as staff turnover, staff training, and allocation of aide staff among shifts might influence whether residents are kept clean and groomed.

Our ability to demonstrate relationships between staffing and quality was restricted by a number of factors. First, our sample size was limited by our need to conduct analysis at the facility level. Resident level analysis would have required disaggregating the staffing data to a resident level, which is not appropriate because residents of a nursing home do not all receive the same staff intensity. Second, staffing data were from OSCAR, which were not highly associated with actual staffing levels according to payroll data. Finally, our sample, a combination of three previously collected data sets, was not a random sample of facilities, limiting the generalizability. Nevertheless, we found meaningful associations between staffing and two different aspects of nursing home quality. Both of these areas, nutrition and hygiene/grooming, represent important quality domains for long-term nursing home residents.

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